SYNOPSIS OF THESIS

Entitled

ECOLOGY OF NEMATODE DISTRIBUTION AND DIVERSITY FROM SOYBEAN FIELD AT GODAVARI BASIN

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Ecology of Nematode Distribution and Diversity from Soybean Field at Godavari Basin

I. Introduction:

Ecology is the study of interrelationships between organisms and their environment. Ecological relationships may be considered at across various levels of biological organization, from the individual to the ecosystem (Organism- Population- Community- Ecosystem- Biosphere). An ecosystem is a natural system that is formed by dynamic interactions between biotic and abiotic components. Each element of abiotic component has its special characteristics and role in the system that, as a function of time and place, will influence the distribution and population of living organisms. A crop agroecosystem is characterized by a much simpler composition with regard to the number of species residing in the system and the relative simplicity of energy flows compared with a natural, stable ecosystem. For better understanding of ecology and distribution is needed to understand abiotic components basically. In that components soil is basic and important component, it plays a vital role regarding distribution and diversity of nematodes. I studied two basic components i.e. Soil properties and distribution and diversity of nematodes.

Soil provides a medium for plant growth to meet our food and fiber need. Soil filters water, decomposes waste, stores heat and exchanges gases and hence have great bearing on environmental balance (Bear, 1976). Fertility of soil is one of the most important factors which regulate growth and yield of crops. Due to an imbalance and an inadequate use of fertilizers, improper irrigation and various cultural practices the soil quality depleting rapidly (Bacchewar and Gajbhiye, 2011). Micronutrients play an important role in maintaining soil health and productivity of crops for the sustainable agricultural production. The information of soil characterization in relation to fertility status of the soils of the region will be useful. In order to meet the ever increasing food requirement for growing population, it is essential that soil and water resources should be used judiciously.

The physico-chemical properties of soil play an important role in determining the retention and availability of nutrients in the soils. The nutrient supply in soils is depends on the level of organic matter, the degree of microbial activity, change in pH types and amount of clay and status of soil moisture.The physico-chemical properties such as soil pH, calcium carbonate ($CaCo_3$) and organic carbon are important as these affects the availability of nutrients in soil and thereby on crop growth and production. Calcium is the secondary nutrient element required by all higher plants absorbed as Ca^{++} ion. It is constituent of cell

wall, increases stiffness of plants and it plays an important role in cell elongation and division, root development and growth of plants.

Magnesium is the constituent of chlorophyll serve as a structural component of ribosome and plays a important role in protein synthesis. Sulphur plays a vital role in soil seed crops, It is important in formation of amino acids i.e. cysteine, cystine and methionine. It is also essential for protein, fatty acid synthesis, enzyme activation, formation of glucosides (Chaudhari and Ahire, 2013, Patil JD and Shingte AK, 1982). Authors find out effect of soil type on population densities and distribution of plant parasitic nematode species (Verginia R. Feris and R. L. Bernard 1971).

The nematodes were known to us in ancient history, the scientific history of nematodes in India is too young. During the last 40 years in India, mainly because of increased demand of food, significant work has been done on survey and identification of plant and soil nematodes (Baquri, 1999).

Nematodes play an important role in ecosystem services like nutrient mineralization, redistribution of other microorganisms involved in nutrient cycling, disease and pest control and system steward ship to enhance desired services. Historically plant and soil nematodes have been related to land use. This is perhaps best reflected by the long-standing regulations in various countries that restrict the planting of crops such as potatoes (*Solanumtuberosum*) and sugarbeet (*Beta vulgaris*) if populations of potato cyst nematode (*Globoderarostochiensis*, *G. pallida*) or beet cyst nematode (*Heteroderaschachtii*) in the particular parcel of land have been locally determined thresholds (Nickle, 1991).

Nematodes are small, non-segmented worms like animals, they are only 50 microns in diameter and (0.3–5.0mm long as adults) which are very abundant (commonly millionsm−2) and diverse (commonly > 30 taxa) in all soils (Yeates, 1979). They are widely distributed in soil, and their communities are made up of diverse species that, according to their feeding habits, can be classified into five major groups: plant parasites, bacterial and fungal feeders, predators and omnivores. The role of nematodes in a soil ecosystem is to recycle nutrients by feeding plant tissue and microorganisms and liberating minerals for easy absorption by plant roots (Gilmar S. Gomes, Shiou P. Huang & Juvenil E. Cares - 2003). The nematode community has been used as an ecological bioindicator (Freckman, 1982; Samoiloff, 1987; Bongers, 1990). They have a resistant cuticle (skin) and an ability to adapt well to environmental change which has enabled them to become the most abundant multicellular animals on earth, most nematode species have a beneficial role in the soil, but we tend to know more about the pest species because of their impact on agricultural production. They

constitute one of the most numerically important components of the soil fauna (warwick et al 2002) and thus significantly in diverse ecosystems. Moreover, nematode populations can respond in predictable ways to ecosystem disturbance (Freckman and Ettema 1993). Parasitic nematodes cause problems in agricultural production because they feed on plant roots and slow plant growth.

Plant parasitic nematodes possess a hollow stylet, mouth part which is like a hypodermic syringe. The stylet is forced into plant cells and enzymes are injected to decompose the cell content. The nematode withdraws the partially digested cell contents through the stylet. Some nematodes such as the root knot and the cyst nematodes establish a specialized feeding site where they remain for the rest of their life cycle. Other nematodes such as the root lesion nematode burrow into the root, feeding and causing damage as they move through the root. When infested plants and roots die in the autumn, root lesion nematodes will move out of the roots into the soil(M.J. Celetti and J. Potter,2006).

Several members of polyspecific nematode community damage soybean *(Glycine max* (L.) Merr.) worldwide (Schmitt, D. P., and G, R. Noel. 1984, Sinclair, J. B., ed. 1982). Expression of nematode damage to soybean may change with many factors, however, including cultivar (Schmitt, D. P., and K. R. Barker,1981), temperature (Nardacci, J. F., and K. R. Barker. 1979), and soil texture (Koenning, S. R., S. C. Anand, andJ. A. Wrather,1988). In some instances, the combined influence of two species on this host was investigated (Ibrahim, K. A., and S. A. Lewis, 1985,Rodrlguez-K~bana, R., and J. C. Williams,1981), resulting in a multivariate function expressing soybean yield.

Soybean is the main oil seed crop in India. The state of Madhya Pradesh, known as the soy state of India, produces about 55% of total production followed by Maharashtra (30%), Rajasthan (9%), Karnataka (2%), Chhatisgarh (1%), Andhra Pradesh (1%), and other states (2%). About 35 diseases have been identified on soybean in India which causes yield loss. But nematode yet not reported as major component of soybean yield loss in India (A. Wrather et. al.2006). Study area reported two nematode genus and two species belongs two genus i.e. *Meloidogyne* spp. and *Rotylenchulus* spp. But their densities varies from location to locations.

The objectives of this study are to determine the soil properties, diversity, distribution, population dynamics, and biomass of nematodes from soybean field at Godavari basin.

II. **REVIEW OF LITERATURE**

Globally fallowing some workers worked / working on nematode,

B.S. Chandrawat et al. (2013) India, Deshmukh Rahul and K.N. Pathak (2013) India, Debanand Das et al. (2013), C. Bhattacharya et al. (2013, 2012), Sudershan Ganguly et al., (2013), Padma Bohra (2012), Matiyar Rahaman Khan et al. (2011), R.K. Jaiswal et al. (2011), Viswa Venkatgantait et al (2010), L. Victoria et al. (2010), Nethi Somasekhar et al. (2010), Matiyar Rahaman Khan and Mohammed Abu Hasan (2010), LI Qi et al., (2009), M. Baniyamuddin et al., (2007), Sudershan Ganguly et al., (2005), Padma Bohra et al., (2005), Padma Bohra and Qaiser H. Baqri (2005), Padma Bohra and Qaiser H. Baqri (2005), S.S. Hussaini et al. (2001), Qaiser H. Baqri (1999), P.F. Rahaman and I. Ahmad (1995), C.H. Dhanachand and E. Khan (1981), India., Maharashtra. The distribution and diversity is carried out by following workers like Daya ram Bhusal et al., (2014), (K.S. Darekar and E. Khan 1981) Yongsan Zeng et al (2012), Eder Matsuo et al. (2012), Min Zhang et al.,(2012), K.K. Chaudhary et al.,(2011), T.I. Olabiyi et al.,(2009), LI Qi et al.,(2009), H.Y. Wu et al.,(2008), Chunian Shi et al.,(2008), Michael A. Poage et al.,(2008), Massarrat Ramzan et al.,(2008), Wang Shi-Bin et al.,(2008), Gabor Bakonyi et al.,(2007), Gregor W. Yeates (2003), G.R. Noel and L.M. Wax (2003), Gilmar S. Gomes et al.,(2002), P.A. Donald et al.,(1999), G.W. Yeates and T. Bongers (1999), Deborah Mc Sorley and John J. Frederick (1996), F. Warner et al.,(1994), K.R. Barker et al.,(1994), T.L. Niblack et al.,(1993), Ernest C. Bernard (1992), A.S. Carpenter and S.A. Lewis (1991), Paul De Ley and Agust Coomans (1990), R. Mc Sorley and D.W. Dickson (1989), Sonya Mobbs Baird and Ernest C. Bernard (1984). Mucksood Ahmad Ganaie and Tabreiz Ahmad Khan (2014), C. Sellaperumal et al.,(2013), Kalyankar Dutta et al.,(2013), C. Bhattacharya et al.,(2012), Matiyar Rahaman Khan et al.,(2011), R.K. Jaiswal et al.,(2011), S.K. Singh et al.,(2010), Anamika et al.,(2010), Nidhityagi et al.,(2010), Kabindra Singh Rathour et al.,(2010), Matiyar Rahaman Khan and Mohammed Abu Hasan (2010), Lalramliana et al.,(2005), India. The work on Root-knot nematode carried out by following workers like A.F. Barros et al., (2014), Martin Gode Froid et al.,(2013), Samuel B. Orisajo (2012), Samuel B. Orisago (2012), M.M. Rahman and I.H. Mian (2010), M.M. Rahman and I.H. Mian (2010), Medhi Nasar Esfahani (2009), A. Khan et al.,(2005), E. Pate et al.,(2000), S.R. Koenning et al.,(1999), Ladislav Hanel (1999), T.A. Wheeler et al.,(1997), L.D. Young (1996), D.W. Dickson and R. Mc Sorley (1990), R. Mc Sorley and D.W. Dickson (1990), R.T. Robbins et al.,(1989), V.R. Ferris et al.,(1971), World.

An ecological study of nematode was carried out by following workers like G.B. Pradhan and M.C. Dash (1987), C.C. Mishra and M.C. Dash (1980), India and Amanda K. Hodson et

al.,(2014), Sergio Rasmann et al.,(2012), Howard Ferris et al.,(2012), Jingnan Zhang et al.,(2010), S. Tianna D. Pont et al.,(2009), Amy M. Treonis and Diana H. Wall (2005), Deborah A. Neher (2001), Gregor W. Yeates (1996), G.W. Yeates et al.,(1993), K.R. Barker (1993), Howard Ferris (1993), Dennis A. Lawn and Gregory R. Noel (1986), World.

III. Materials and Methods:

Study Area:

The Godavari Basin of Marathwada (Maharashtra, India) is popular for cultivation of soybean, sugarcane and cotton. For study I have selected 12 locations from Jalna and 12 locations from Beed District belong to Godavari basin. Geographically the selected location of Jalna lies between N=19°23'02.3" - 19°18'23.6" latitude and E= 075°38'27.7" - 075°57'52.0" longitude and Beed district are N=19°17'22.8" - 19°16'52.1" latitude and E= 076°09'44.2"- 076°09'34.6" longitude as tabulated in table no. 1.

Table No.1:- GPS location and collection site from study area

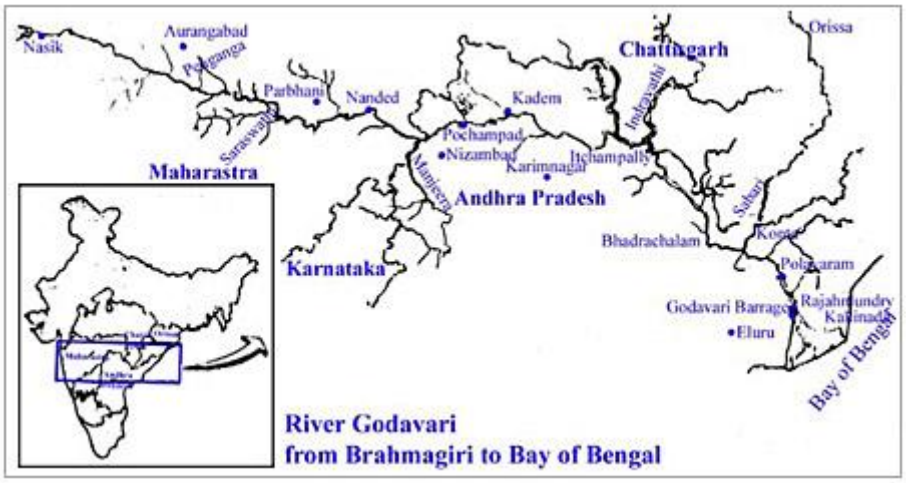
A. Jalna District:

Sr. No.	N	E	Location
1	19°23'02.3"	075°38'27.7"	SasthaPimpalgaon
2	19°23'17.5"	075°36'54.0"	Balegaon
3	19°23'01.3"	075°38'27.8"	Apegaon
4	19°23'58.8"	075°.48'43.8"	Hasnapur
5	19°23'57.8"	075°47'42.7"	Ganesh Nagar
6	19°24'02.4"	075°52'27.0"	Sadegaon
7	19°23'40.2"	075°54'05.7"	Jogladevi
8	19°22'39.2"	075°50'04.7"	Ramasgaon
9	19°21'11.8"	075°54'19.7"	Banegaon
10	19°20'43.2"	075°54'13.4"	Bhoggaon
11	19°18'23.6"	075°57'52.0"	Mangrul
12	19°17'22.8"	076°09'44.2"	Golegaon

B. Beed District

Sr. No.	N	E	Location
1	19°23'02.4"	075°39'28.9"	Rakshshbhavan
2	19°21'25.5"	075°41'45.4"	Khamgaon
3	19°23'58.4"	075°48'43.8"	Kat Chincholi
4	19°23'03.1"	075°54'13.9"	Bhogalgaon
5	19°23'11.9"	075°54'48.0"	Borgaon
6	19°20'10.7"	075°51'20.8"	Raheri
7	19°17'21.2"	075°54'34.9"	Rajapur
8	19°17'44.2"	075°57'43.2"	ManubaiJawla
9	19°15'05.9"	076°01'47.5"	Ram Nagar
10	19°14'44.4"	076°04'34.1"	SurdiNagik
11	19°15'44.3"	076°05'34.0"	Kavadgaon
12	19°16'52.1"	076°09'34.6"	Purushottampuri

Fig: 1: Map showing Godavari Basin of Marathwada including Jalna and Beed district from which soil samples are collected



Methodology:

A. Soil Analysis:

Soil samples were collected from same localities from study area. The processed soil samples were analyzed for their physic-chemical properties like Soil pH (Shoemaker *et al.*, 1961); free $CaCo_3$ (Methods Manual, 2011). Organic carbon (Walkly and Black 1934); Exchangeable calcium and magnesium (Patil and Shingte, 1982). Sulphur and E.C. was determined by electrometrically (Methods Manual, 2011) at Krishi Vidgyan Kendra, Kharpudi Dist: Jalna.

B. Nematode Collecton:

Nematodes were extracted from the samples using the Baerman Funnel technique (Southey; 1970). Root-knot nematodes were extracted from the galls present on the roots and species identification was based on perineal pattern morphology. Nematodes were identify using binocular or stereoscopic microscope and standard keys of Goodey(1963); Andrassy (1968,1979,1980,1984), Maggenti (1983,1991); Bongers (1987); Maggenti et al (1987), Nickle (1991); Hunt (1993).

IV. Results and Discussion:

Soil Parameters:

Soil is an important natural resource and plays a crucial role in maintaining environmental balance (R. Chandra and S.K. Singh, 2009). Its proper use greatly determines the capability of life support system and socio-economic development of nation (Chaudhari and Ahire, 2013). The present study was carried out during August 2010 to October 2010, August 2011 to October 2011, August 2012 to October 2012 for to study the distribution and diversity of nematodes in soybean field of Godavari Basin at Jalna and Beed District and also understand the role of effect on soybean yield.

The result of soil parameters of selected locations during the study period as pH values ranges between 7.1 to 8.9. The E.C. values ranges between 0.20 to 0.38 m/s, The values of organic carbon ranges between 0.35 to 0.95%, P_2O_5 values ranges between 49.0 to 89.9k/hec , K_2O values are recorded in between 679 to 901k/hec , Ca values are recorded in between 18.0 to 40.0m/100gm, Mg values are recorded in between 11.2 to 30.4m/100gm, Na values are recorded between 107 to 128m/100gm, $CaCo_3$ values are recorded between 8.35 to 15.6%.

Nematode and their distribution:

Recent ecological studies of soil nematode communities have focused on individual taxa and on indices of community structure (Wasilewska, 1991; Freckman & Enema, 1993; McSorley, 1993; Neher & Campbell, 1994; Wasilewska, 1994; Yeates & Bird, 1994). Such indices may prove useful as indicators of agriculrural management (Freckman & Enema, 1993; Yeates & Bird, 1994) or ecosystem health (Neher & Campbell, 1994). Although relationships between crop performance and densities of single plant-parasitic nematode species are well-recognized (McSoriey & Phillips, 1993). Some way I have studied their distribution and densities of nematode from soybean field of study area. I observed two species belongs to two genus i. e. *Meloidogyne* and *Rotylenchulus* but they are not suppose to yield loss of soybean from study area. *Meloidogyne* species constitute the major nematode problem in developing countries. It is highly pathogenic to some staple crops such as cereals, including rice, maize, potato, soybean, banana, plantain, sweet potato and yam; or industrial crops such as tobacco, coffee, sugar cane, sugar beet, cotton and black pepper. But this area not shows significant effect of nematode due to its moderate population. If we see scenario in other countries US, Canada, Brazil etc *Heterodera* and *Meloidogyne* affect on both way i. e. quality and quantity of soybean (Sasser 1980) individually *Rotylenchulus* loss 2691.9 thousand tones loss annually around the world (www.plantmanagment.org).

The nematode species reported during study period are *Meloidogyne* and *Rotylenculus* in all location but their density is varies. Various workers stated that this species loss soybean yield globally (A. Wrather and G. Shannon, 2006) but in India not yet significant role in yield loss. This study tries to understand soil properties in relation to distribution of nematodes in soybean field of Godavari Basin (Marathwada, Maharashtra).

Significance/ why important of study:

1. Significant of my primary research in the said area is an important regarding ecology, soil property, role of nematodes in the quality and quantity of soybean and their scenario.
2. Analysis of the diversity and complexity of nematode communities in the soil is a valuable tool which indicates soil biological fertility or soil health.
3. Nematode species composition or the presence or absence of key species may be useful ecological and environmental indicators.
4. Co-relation of soil and nematode diversity and distribution.
5. These studies may provide information about diversity and distribution, yield loss and other related scenario of study area. This may be helpful regarding data built up for further research in agriculture.

Research Student	Co-Guide	Research Guide
(Mr. Phalke G.B.)	(Dr. Mohan Babre)	(Dr. Laxmikant V. Shinde)